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SUBJECT: CCMS: GEOTHERMAL ENERGY PROJECT

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1. SUMMARY: U.S. CCMS GEOTHERMAL TEAM HAD VERY SUCCESSFUL THREE-
DAY VISIT TO ICELAND. THE TECHNICAL COMPETENCE OF THE
ICELANDERS IN THIS DISCIPLINE IS OUTSTANDING AND THEY HAVE
MUCH TO CONTRIBUTE. THE TEAM SAW OFFICIALS OF THE REYKJAVIK
HOT WATER AUTHORITY, NATIONAL ENERGY AUTHORITY (NEA), NATIONAL
RESEARCH COUNCIL (NRC), AND MINISTER OF INDUSTRY. ALL WERE
INTERESTED IN MULTINATIONAL COOPERATION WITH U.S. AND OTHERS IN
GEOTHERMAL FIELD. MINISTER OF INDUSTRY (COMMUNIST) INDICATED
GENUINE INTEREST IN RECEIVING PROPOSAL FROM US FOLLOWING
VISITS IN OTHER COUNTRIES. HE HAD BEEN FAVORABLY IMPRESSED
BY DR. GERALD W. JOHNSON OF THE AEC WHO VISITED HIM EARLIER
THIS YEAR, ASKED ABOUT HIM, AND SPECIFICALLY INDICATED THAT A
JOINT RESEARCH PROGRAM WITH THE AEC WOULD BE WELCOME.

GROUP VISITED HOT WATER AUTHORITY'S REYKJAHLITH GEOTHERMAL
FIELD, AND REYKJANES PENINSULA, SITE OF PROPOSED 250,000 TON SEA
CHEMICALS PLANT FOR SALT AND INDUSTRIAL CHEMICAL EXTRACTION FROM
GEOTHERMAL BRINE AND SEA WATER. AREAS IN WHICH GOI EXPRESSED
INTEREST IN COOPERATION INCLUDED SILICA REMOVAL OR TREATMENT
TO REDUCE SCALING IN GEOTHERMAL EQUIPMENT, BRINE DISPOSAL
AND REINJECTION PROBLEMS, EXTRACTION OF MINERALS FROM GEOTHERMAL
BRINE AND SEA WATER, GENERATION OF ELECTRICITY USING GEOTHERMAL
POWER (INCLUDING LOW TEMPERATURE BINARY SYSTEMS), AND MULTIPLE
USE OF GEOTHERMAL ENERGY (G.G., ELECTRICITY GENERATION AND HOT
WATER FOR SPACE HEATING).

U.S. TEAM DECIDED NOT RPT NOT TO RAISE POSSIBLE NAVAL
BASE PURCHASE OF GEOTHERMAL HOT WATER FROM SVARTSENGI
PROJECT IN LIGHT OF THE COST ANALYSIS PRESENTED BY NEA
(SEE PARA 3 BELOW) AND GENERAL ICELANDIC INTEREST EXPRESSED
IN COOPERATIVE PROJECTS INVOLVING HIGHER TECHNOLOGY CONTENT.
U.S. TEAM ALSO CONSIDERED US-ICELAND RELATIONS IN MAKING
DECISION. ICELANDIC COST STUDY WOULD SEEM TO INDICATE THAT
THE SVARTSENGI PROJECT COULD PROCEED IN TERMS OF SUPPLYING
LOCAL COMMUNITIES WITHOUT REFERENCE TO NATO BASE. IT WOULD
ALSO BE ECONOMICALLY COMPETIVE WITH HEAT SUPPLIED NOW
BY FUEL OIL. END SUMMARY
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2. REVKJAVIK MUNICIPAL HOT WATER AUTHORITY
GROUP MEET WITH DIRECTOR JOHANNES ZOEGA AND GEN. GUNNAR
KRISTINSSON. AUTHORITY SUPPLIES GEOTHERMAL HOT WATER FOR
HEATING AND HOUSEHOLD USE TO ENTIRE REYKJAVIK AREA, RE-
QUIRING AUXILIARY POWER ONLY APPROXIMATELY 10 DAYS/YEAR.
TOTAL ENERGY DELIVERED BY SYSTEM IN 1970 EQUIVALENT OF
1170 MILLION KWH TERMAL. THERMAL WELLS LIE UNDER THE CITY
AND IN TWO SEPARATE LOCATONS TO NORTHEAST OF MUNICIPAL
AREA AT MAXIMUM DISTANCE OF 15 KILOMETERS FROM CITY LIMITS.
GROUP VISITED REYKJAHLITH FIELD AND INSPECTED LARGEST
ICELANDIC DRILLING RIG, CAPABLE OF 200 METER DEPTH, IN
PROCESS OF DRILLING NEW WELL. RIG IS TYPICAL INTERMEDIATE

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TYPE SIMILAR TO THAT FOUND IN US OIL FIELDS. DRILLING
OPERATIONS ARE COMPARABLE WITH THOSE USED BY US OIL DRILLERS
EXCEPT THAT GENERALLY ONLY DRILLING FLUID USED WAS WATER.
ALTHOUGH 92 BOREHOLES WERE DRILLED IN THE THREE HOT WATER FIELDS,
ONLY ONE BLOWOUT HAS BEEN EXPERIENCED. A NEW 24 " PIPE
LINE IS UNDER CONSTRUCTION FROM THE EXPANDED FIELD TO THE CITY.
WHEN THE SYSTEM IS COMPLETE, IT WILL PROVIDE FOR PUMPING 4,000
CUBIC METERS PER HOUR OF 80 DEGREE C. WATER TO REYKJAVIK. ALL
DRILLING AND PUMPING EQUIPMENT AT SITE WAS OF AMERICAN
MANUFACTURE.

WATER IS OF DRINKING QUALITY AND POSES MINIMAL SCALING
PROBLEM (LESS THAN 1 PER CENT PER YEAR OF CAPITAL COST FOR
MAINTENANCE), HOWEVER, DETECTABLE HYDROGEN SULPHIDE IS
PRESENT. IN INTERMEDIATE DEPTH FIELDS H 2 S LEVEL IS BROUGHT
DOWN TO 1 CC/KILOGRAM OF WATER. DEGASSERS ARE SITUATED ON EACH WELL
PLUS AT CENTRAL COLLECTION POINT. THE H 2 S LEVEL IS BROUGHT
DOWN TO 1 CC/KILIGRAM OF WATER BEFORE GOING INTO THE MAIN
DISTRIBUTION LINES. IN THE HIGH TEMPERATURE FIELDS SUCH AS
NESJAVELLIER, THE H 2 S CONTENTS ARE AS HIGH AS 5 LITERS/KILOGRAM
OF WATER. ON THE OTHER HAND, APPARENTLY NO CHEMICAL ANALYSES
HAVE BEEN MADE ON FLUIDS FROM ANY SITE FOR OTHER POTENTIALLY
HAZARDOUS SUBSTANCES SUCH AS ARSENIC. ZOEGA NOTED THAT DUE
TO CONSTANT REFILLING BY GROUND WATER, THE HOT WATER SUPPLY
REMAINS AT RELATIVELY CONSTANT LEVEL. THIS COUPLED WITH
THE NATURE OF VOLCANIC ROCK PREVENTS LAND SUBSIDENCE.
REYKJAVIK AUTHORITY HAS RECENTLY IN CONJUNCTION WITH THE
DRILLING AUTHORITY OF NEA DRILLED AN 1800 METER DEEP
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EXPLORATORY WELL AT NESJAVELLIR NEAR LAKE THINGVALLAVATN,
30 KILOMETERS EAST OF REYKJAVIK. INDICATIONS ARE THAT
AN EXTENSIVE FIELD OF 280 O GETHERMAL WATER EXISTS IN THIS
REGION. DUR TO DISCOVERY OF NEW WELLS NEARER REYKJAVIK,
THE FIELD HAS NOT YET BEEN DEVELOPED. HOWEVER REYKJAVIK
AUTHORITY CONSIDERS THAT SYSTEM WILL BE BROUGHT INTO
OPERATION WITHIN NEXT 10 YEARS.WHILE COST OF DELIVERED HOT
WATER IS EXPECTED TO BE 150 PER CENT OF PRESENT COST, IT SHOULD
BE COST EFFECTIVE IN COMPARISION WITH ELECTRICITY AND FUEL OIL
AT PRESENT PRICES. PROPOSED NESJAVELLIR SYSTEM WOULD
PROBABLY USE HEAT EXCHANGERS AS WELL AS MIXING WITH
SURFACE WATERS TO REDUCE TEMPERATURE, ALTHOUGH TRANSPORT OF
LIVE STEAM HAS BEEN CONSIDERED. IN THE EVENT OF USING HEAT
EXCHANGERS, THE THERMAL WATER WOULD BE REINJECTED.
THERE IS ALSO COST EFFECTIVE POSSIBILITY OF ELECTRIC
GENERATION AT SITE TO PROVIDE POWER FOR PUMPS. ECONOMIC
STUDIES INDICATE THAT GEOTHERMAL ELECTRICAL ENERGY WILL BE
CHEAPER THAN HYDRO IF USED IN TANDEM WITH HOT WATER SPACE
HEATING. TEAM LEARNED LATER AT NEA THAT WHILE GENERAL
ELECTRICAL GENERATION IS BETTER FROM TECHNICAL AND
ECONOMIC POINT OF VIEW FROM NESJAVELLIR, THIS DID NOT FIT IN

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WITH OVERALL POLICICAL DECISION TO DEVELOP NORTH OF ICELAND.
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SUBJECT: CCMS: GEOTHERMAL ENERGY PROJECT

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3. NATIONAL ENERGY AUTHORITY

GROUP RECEIVED BY DR. GUDMUNDUR PALMASSON, HEAD OF DEPARTMENT OF NATURAL HEAT, ENG. SVEINBJORN BJORNSSON (PARTICULARLY IMPRESSIVE) AND SIGURDUR BENEDIKTSSON. NEA IS DIVIDED INTO FIVE SECTIONS; DEPARTMENT OF HYDROPOWER RESOURCES, DEPARTMENT OF NATURAL HEAT, DEPARTMENT OF DRILLING, DEPARTMENT OF ADMINISTRATION AND DEPARTMENT OF STEAM SUPPLY. NEA IS NOT DISTRIBUTION AGENCY BUT DOES ENGAGE IN GEOTHERMAL PROSPECTING AND FRILLING. PALMASSON NOTED THAT THERE WAS A PROBLEM IN ICELAND WITH RESPECT TO OWNERSHIP OF GEOTHERMAL RIGHTS AND THAT A BILL WAS PENDING BEFORE THE ALTHING WHICH WOULD GRANT THESE RIGHTS TO THE STATE. PALMASSON NOTED THAT NEA HAD ON ITS STAFF 15 PROFESSINALS (GEOLOGISTS, GEOPHYSICISTS, GEOCHEMISTS, ENGINEERS), 5-10 TECHNICIANS AND 15-20 STUDENTS (FOR SUMMER FIELD WORK).

NEA OFFICIALS THEN DESCRIBED REYKJANES SEA CHEMICALS PROJECT (SEE PARA 4 BELOW), SVARTSENGI/KEFLAVIK HOT WATER AND SPACE HEATING PROJECT, AND PLANS FOR ELECTRICITY GENERATION USING GEOTHERMAL POWER.

A) SVARTSENGI/KEFLAVIK HOT WATER AND SPACE HEATING PROJECT:

NEA HAS EXPLORED SVARTSENGI GEOTHERMAL AREA AND BELIVES IT T BE MOST RELIABLE AND COST-EFFECTIVE SITE FOR GEOTHERMAL HOT WATER PRODUCTION FOR KEFLAVIK AREA. KEFLAVIK ITSELF NOT LOCATED IN RIFT ZONE: GEOTHERMAL WATER THERE IS COOLER (APPROXIMATELY 100 DEGREES C. PER 100 METERS DEPTH AS OPPOSED TO 160 DEGREES C PER 100 METERS DEPTH AT SVARTSENGI); FURTHER EXPLORATION AT KEFLAVIK WOULD BE COSTLY: AND COST ANALYSIS SHOWS THAT SVARTSENGI CAN SUPPLY VERY CHEAP ENERGY FOR SPACE HEATING AND HOT WATER TO ENTIRE PENINSULA.

FOLLOWING ON FROM PROJECT WHICH HAS BEEN UNDERWAY FOR ONE YEAR, NEA INTENDS THIS YEAR TO COMMENCE PILOT TESTING OF HEAT EXCHANGER EQUIPMENT TO BRING WATER TEMPERATURE FROM 200 DEGREES C TO 85 DEGREES C (USING 400 METER WELLS IN SVARTSENGI AREA).

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WHEN LOCAL COMMUNITIES (AS IS EXPECTED) INDICATE GENERAL AGREEMENT TO PROJECT AND ICELANDIC PARLIAMENT GIVES GO-AHEAD, NEA INTENDS IN 1974 TO DRILL TWO EXLORATORY 200 METER WELLS (COST DOLS3000,000). IF THIS FURTHER TESTING PRODUCES NO TECHNICAL SURPRISES, NEA FEELS THAT PRODUCTION DEVELOPMENT OF SVARTSENGI AREA COULD PROCEED THEREAFTER, PROBABLY BEGINNING IN 1975. NEA CONTEMPLATES USING HEAT EXCHANGERS TO LOWER WATER TEMPERATURE PUMPING HIGH TEMPERATURE GEOTHERMAL WATER

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NAD BRING INTO NATURAL FISSURES PRESENT IN AREA RATHER THAN
REINJECTION (SEAWATER AT AVERAGE DEPTH OF 30 METERS), AND
USING ASBESTOS PIPES TO TRANSPORT HOT WATER TO COMMUNITIES.

PROPOSED SVARTSENGI PROJECT IS DESIGNED FOR TWO PHASES:
THE FIRST SUPPLYING 30 MEAWATTS TERMAL TO THE LOCAL COMMUNITIES
AND 15 MEGAWATTS THERMAL TO KEFLAVIK AIRPORT (PROBABLY NOT
INCLUDING THE NATO BASE), AND THE SECOND SUPPLYING A FURTHER
45 MEAGAWATTS TERMAL TO THE BASE. (N.B. TEAM UNDERSTANDS
NATO BASE (INCLUDING ICELANDIC FACILITIES) HAS 70 MEGAWATT
THERMAL DEMAND. PHASE 2 WOULD ONLY SUPPLY 60 MEGAWATTS
THERMAL TO THE BASE.)

ICELANDIC COSTS ANALYSES BY RANGERS (NEA) AND BJORNSSON
(DATED JAN 1973) INDICATES THAT GEOTHERMAL MEGAWATTS WOULD
HAVE TO SOLD AT THE DISTRIBUTION POINT TO END USERS
LOCATED INTHE KEFLAVIK PENINSULA AT LESS THAT APPROXIMATELY
DOLS.0057/KWH TERMAL (KR. 0.501 KWH) INORDER FOR THIS COURCE
OF POWER TO BE COMPETIVE WITH OTHER POWER SOURCES (G.G., FUEL
OIL). SINCE ACCORDING TO LUDVIKSSON (NRC) ALL BUIDLINGS IN
THE AREA ARE HEATED BY RADIATOR SYSTEMS, THE ONLY ADDITIONAL
COST FOR CONVERSION TO GEOTHERMAL HEATING IS PIPING WITHIN
THE COMMUNITIES FROM THE DISTRIBUTION POINTS TO THE BUILDINGS.
THIS ADDITIONAL COST WOULD PRESUMABLY HAVE TO BE COMPARED
WITH PRESENT COSTS OF TRUCKING FUEL OIL FOR HEATING. ASSUMING
THAT THESE COSTS ARE COMPARABLE, THE DOLS.0057/KWH RATE DESCRIBED
ABOVE IS THE BREAK-EVEN RATE FOR SALES OF GEOTHERMAL POWER
IN THE AREA. ICELANDIC COST ANALYSIS PLOTS COST/KWH OF PHASE 1.
AT APPROXIMATELY DOLS.0024 AND PHAWE 2 AT APPROXIMATELY DOLS.0022,
BOTH UNDER HALF THE BREAK-EVAN RATE. IN ADDITION, ICELANDIC
STUDY COST CURVE SHOWS THAT 60 MEGAWATTS THERMAL COULD BE
SUPPLIED AT A BREAK-EVEN PRICE OFDOLS.0023/KWH TERMAL. ESSENTIALLY,
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ONCE 45 MEGAWATTS ARE SUPPLIED TO 3 :9..7,8583 (INCOUDING 15
MEGAWATTS TO ICELANDIC FACILITIES AT BASE), ADDITIONAL ENERGY
SUPPLY UP TO 90 MEGAWATTS (WHICH COULD ONLY BE USED FOR BASE) WOULD
RESULT IN A PRICE/KWH DECREASE OF 8/3 PERCENT. ABOVE COST FIGURES
BASED ON AMORTIZATION OF 25 YEARS FOR TRANSPORT PIPES AND 10
YEARS FOR THE WELLS. DESPITE 16 PERCENT INFLATION, THE DISCOUNT
FACTOR WAS ASSUMED AT 8 PERCENT. COSTS ALSO CALCULATED AT HEAT
REDUCTION FROM 200O C TO 120 O C. THIS IS A CONSERVATIVE ESTIMATE
OF THE TEMPERATURE RANGE SINCE 240 O C GEOTHERMAL FLUIDES HAVE
BEEN ENCOUNTERED ON THE PENINSULA.

IN OPINION OF US TEAM, INSUFFICIENT ECONOMIES OF SCALE
(I.3 PERCENT DECRESE IN BREAK-EVEN PRICE/KWH TERMAL) IS NOT RPT
NOT OF GREAT SIGNIFICANCE FROM PINT OF VIEW OF GOI IN
DECIDING TO BEGIN PHASE 1. HOWEVER, PRICES INDICATED ABOVE
ARE BREAK-EVEN AND SALES OF GEOTHERMAL ENERGY TO THE BASE
WOULD UNDOUBTEDLY INCLUDE A PROFIT FACTOR.

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B) PROPOSED 10-50 MAGAWATT ELECTRICITY GENERATION POWER
IN MUVATN AREA:

AN ADDITIONAL LARGE HYDRO-ELECTRIC PLANT IN MYVATN AREA
HAS BEEN BLICKED BECAUSE OF ENVIRONMENTAL CONCERNS. HOWEVER,
GOI CONSIDERING INSTALLATION AFTER 1975 OF 10-50 MEGAWATT
GEOTHERMAL POWER PLANT NEAR KRABLA IN SAME AREA. HOWEVER, DUE
TO OTHER ENVIRONMENTAL CONCERNS (DRYING UP LOCAL THERMAL BATHS,
AND BRING AND THERMAL POLLUTION INTO A NEARBY LAKE), ANY NEW
PLANT WOULD PROBABLY BE LOCATED AT KRABLA WHICH IS 19 KILIMETERS
NORTH OF THE MYVATN AREA. PRELIMINARY ESTIMATES INDICATE THAT
SUCH A PLANT WOULD BE COST-EFFECTIVE. TOTAL ELECTRICITY PRODUC-
TION IN ICELAND IS APPROXIMATELY 350 MW: 50 MW POWER PLANT WOULD
THUS PROVIDE FOR SIGNIFICANT INCREASE. GIVEN FACT THAT ICELANDIC
DEMAND FOR ELECTRICITY ONLY INCREASE AT RATE OF 8-10
MEGAWATTS PER YEAR, STAGED INSTALLATION OF GEOTHERMAL ELECTRICTY
PLANT MAY BE PARTICULARLY USEFUL. NEA OFFICIALS INDICATED
THAT ECHNICCALLY, ECONOMICALLY AND ENVIOROMENTALLY IT WOULD
PROBABLY MAKE MORE SENSE TO GENERATE ELECTRICITY IN
THE NESJAVELLIR AREA USNG LAKE THINGVALLAVATN FOR COOLING
WATER. POLITICALLY, THE ICELANDERS WANT TO DEVELOP THE
NORTH: SO THE FIRST PLANT WILL BE LOCATED AT KRABLA. THIS
EXPLAINS THE REASON WHY THE REYKJAVIK HEATING AUTHORITY
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IS ONLY CONSIDERING GENERATION OF POWER FOR USE EXCLUSIVELY
BY THEIR PROPOSED HEATING PLANT AT NESJAVELLIR.
PROSPECTING TECHNIQUES USED BY NEA INVOLVE GEOCHEMISTRY,
ELECTRICAL RESISTIVITY AND THERMAL GRADIENT MEASUREMENTS
PRIMARILY. ICELANDERS ALSO USE GRAVITY AND MAGNETICS.

NEA OFFICIALS INDICATED GREAT INTEREST IN CCMS PROJECT,
PARTICULARLY WITH RESPECT TO INFORMATION EXCHANGE, ELECTRICITY
GENERATION, PREVENTION OF SILICA SCALING, PERHAPS REINJECTION,
AND BINARY POWER SYSTEMS.
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4. NATIONAL RESEARCH COUNCIL

DIRECTOR STEINGRIMUR HERMANSSON, WHO IS ALSO A MEMBER
OF PARLIAMENT, VILHJALMUR LUDVIKSSON BRIEFED THE
US TEAM ON THE DUTIES OF THE NATIONAL RESEARCH COUNCIL. NRC
HAS THREE MAJOR PROGRAM AREAS 1) SCIENCE POLICY, 2) UTILIZATION
OF NATURAL RESOURCES: AND 3) ESTABLISHMENT OF INTERNATIONAL
COOPERATION.HERMENNSSON THENDISCUSSED THE USES OF GEOTHERMAL
HEAT FOR INDUSTRIAL PURPOSES. HE INDICATED THAT THERE ARE FIVE
SPECIFIC PROGRAMS AND THESE WERE LISTED IN ORDER OF COMPLETION.

A) THE DIATOMITE DRYING FACILITY IN THE MYVATN AREA WHICH
IS ON LINE.

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B) A PROJECT IN NORTHWEST ICELAND TO DRY SEAWEEK USING
100 O C GEOTHERMAL WATERS WHICH WILL BE IMPLEMENTED BY 1975.

C) A SEA CHEMICALS PROJECT IN THE REYKJANSS AREA (THE
LARGEST OF THE PROJECTS) MAY BE IMPLEMENTED NEXT YEAR.
THE PLAN IS INITIALLY TO RECOVER SODIUM CHLORIDE,
POTASSIUM CHLORIDE, CALCIUM CHLORIDE AND BROMINE FROM
THE GEOTHERMAL BRINES. NRC'S FINAL REPORT HAS
BEEN SUBMITTED TO THE MINISTRY OF INDUSTRY.

D) A STUDY OF THE INTEGRATED USE OF GEOTHERMAL ENERGY,
I.E., THE TOTAL USE OF THE AVAILABLE ENERGY.THIS PROJECT
IS ONLY IN THE STARTING STAGES.

E) A FINAL PROJECT THAT HE MENTIONED WAS THE USE OF
GEOTHERMAL HEAT FOR IMPROVING THE GREENHOUSE INDUSTRY.

DETAILS FOLLOW:

DIRECTOR HERMANNSSON REVIEWED WORK OF NRC (WHICH REPORTS
TO MINISTER OF EDUCATION) NOTING THAT IT HAD BEEN CHARGED WITH
DEVELOPING ICELANDIC SCIENCE POLICY BUT HAD THUS FAR BEEN
UNSUCCESSFUL IN THIS ENDEAVOR. NRC HAS CONCENTRATED MORE ON
GEOTHERMAL HEATING AND ITS USE IN INDUSTRY THAAN ANY OTHER SOURCE
OF ENGERY. NRC HAD PROMOTED DIATOMITE DRAYING PLANT AT
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LAKE MYVATN WHERE 3 MW OF ELECTRICITY ALREADY GENERATED FROM
GEOTHERMAL SOURCES. DIATOMITE PLANT OWNED 48 PERCENT BY JONS
MANSVILLE AND BALANCE BY GOI. NRC ALSO HAS AT DEVELOPMENTAL
STAGE A PROJECT FOR GEOTHERMAL DRYING OF SEAWEEK IN NW ICELAND
FOR USE IN AGGLUTINATE PREPARATION. PROJECT WELL ADVANCED
AND WILL BE ON LINE IN 1975 WITH POSSIBLE PORODUCT SALE IN
SCOTLAND.

THE THIRD PROJECT WHICH IS ALMOST AT THE PILOT
PLANT STAGE INVOLVES MINERALS EXTRACTION FROM GEOTHERMAL BRINE
AND SEA WATER AT THE REYKJANES PENINSULA. THE DEEPEST WELL IS
1780 METERS WITH A BOTTOM TEMPERATURE OF 296 O C AND ABRINE
INFLOW TEMPERATURE OF 286 O C. HOWEVER, HYDROGEN ISOTOPS
DATA SUGGEST THAT THE WATER MAY HAVE REACHED 400 O C AT GREATER
THAN DRILLED DEPTH. THERE HAS BEEN MUCH DEPOSITION OF
SILICA AND SOLFATES IN THE SUBSURFACE AND IT IS EXPECTED THAT
THIS WILL PREVENT THE ENCROACHMENT OF COLD SEA WATER AFTER
PRODUCTION STARTS.

PROJECT IS CURRENTLY UNDER REVIEW BY INDEPENDENT CONTRACTOR
FOR MINISTRY OF INDUSTRY. THIS PROJECT WILL BEGIN WITH ANNUAL
PRODUCTION OF 250,00 TONS OF SALT (SODIUM CHLORIDE) FOR
FISHING INDUSTIES (PLUS 2500 TONS OF POTASSIUM CHLORIDE,
60,000 TONS OF 80 PER CENT CALCIUM CHLORIDE AND 700 TONS OF

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BROMINE) AND EXPAND IN FOLLOWING STAGES TO INCLUDE SODA ASH, CAUSTIC, AND CHLORINE (PERHPAS USED FOR MANUFACTURE OF CHLORINATED HYDROCARBONS). LAST STAGES WOULD INVOLVE PRODUCTION OF MAGNESIUM AND SODIUM. INITIAL COST OF PLANT IS ESTIMATED AT DOLS 13.5 MILLION (DOLS 12.2 MILLION FOR ON-SITE INVESTMENT AND DOLS 1:3
MILLION FOR A STORAGE AND TRANSPORT FACILITIES). YEARLY OPERATING COST IS EXPECTED TO BE DOLS 3.6 MILLION INCLUDING 15 PERCENT

DEPRECIATION AND INTEREST. FULL CAPACITY PRODUCTION EXPECTED TO YIELD DOLS 495,00 NET ANNUAL PROFIT BEFORE TAX: BREAK-EVEN POINT IS PRODUCTION AT 64 PER CENT CAPACITY. NRC TECHNICAL EXPER-IMENTS SHOW THAT CORROSION AND SCALING FROM BRINE ARE RELATIVELY MINOR PROBLEMS AS RESULT OF SIMPMLICICATION IN PLANT DESIGN AND OPERATION.

US TEAM VISITED TEST WELL SITES AND NOTED HIGH LEVEL
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OF NOISE AND SOME HYDROGEN SILFIDE EMISSION. HOWEVER, REYKJANES PENINSULA VERY ISOLATED.

HEAVY WATER PRODUCTION HAS BEEN PROPOSED, BUT NOW LARGELY ABANDONED BECAUSE OF UNCERTAIN MARKET. IN ADDITION, ICELANDERS HAVE CONSIDERED USING GEOTHERMAL ENERGY FOR DRYING HAY AND EXPANDING THEIR GREENHOUSE HEATING TO RAISE FLOWERS FOR EXPORT.

HERMANNSSON OBSERVED THAT A NUMBER OF ICELANDIC GEOTHERMAL SCIENTISTS ARE WORKING AS UN CONSULTANTS POSING A DRAIN ON ICELAND'S TALENTS. MINISTER KJARTANSSON SAID IN INTERVIEW THAT INSUFFICIENT EMPLOYMENT OPPLRTUNITIES FORCED ICELANDERS GEOTHERMAL SCIENTISTS TO GO ABROAD.

HERMANNSSON INDICATED CONSIDERABLE INTEREST IN CCMS PROJECT AND SUGGESTED THAT NRC BE CONTACT POINT IN GOI. HE STATED THAT IF US CALLED MEETING IN FALL ICELAND WOULD PARTICIPATE. PRINCIPAL NRC INTERESTS IN INTERNATIONAL COOPERATION INVOLVE PREVENTION OF SILICA SCALE, ELECTRICITY CONVERSION, ENVIRONMENTAL CONTROL TECHNIQUES, EXTRACTION OF MINERALS FROM SEA WATER, AND TAPPING HOT ROCK (DUE TO LOW PERMEABILITY IN NESJAVELLIR AREA). NRC INDICATED THAT TOTAL GEOGHERMAL ENERGY POTENTIAL IN ICELAND WAS EQUIVALENT OF SEVEN MILLIONS TONE OS OIL PER YEAR.

5. MINISTER OF INDUSTRY MAGNUS KJARTASSON

HODSOLL EXPLAINED THAT PURPOSE OF VISIT WAS TO ENCOURAGE ICELANDIC PARTICIPATION IN PROPOSED CCMS GEOTHERMAL PROJECT. HE NOTED THAT ICELAND HAD GREAT DEAL TO OFFER IN ANY INTERNATIONAL EXCHANGE OF TECHNOLOGY IN THIS FIELD. HE SAID

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THAT IS WAS US INTENTION, AS PILOT COUNTRY, TO SEEK SILENT
CONSENT FOR PARTICIPATION OF JAPAN, NEW ZEALAND AND MEXICO
IN PROJECT AND THAT WE WERE CONSIDERING ORGANIZATIONAL
MEETING IN US IN THE FALL. HODSOLL CONCLUDED BY SAYING
THAT TEAM WOULD BE SOLICITING IDEAS FROM OTHER COUNTRIES
AND FOLLOWING RETURN TO US WOULD CIRCULATE PROPOSALS
FOR PROJECT. MEMBERS OF US TEAM REVIEWED PARTICULAR
ASPECTS OF GEOTHERMAL ENERGY OF INTEREST TO THEIR RESPECTIVE
AGENCIES.
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MINISTER MENTIONED HIS EARLIER DISCUSSIONS WITH DR. JOHNSON
(AEC) AND STATED HE LOOKED FORWARD TO CONCLUSION OF BILATERAL
ARRANGEMENT WITH US IN THIS RESPECT. HODSOLL NOTED THAT HE
US TEAM VISIT WAS IN PARTIL FOLLOW-UP TO JOHNSON VISIT AND
THAT SOME PARTS OF GEOTHERMAL ENERGY TECHNOLOGY EXCHANGE
COULD BE MORE EFFICIENTLY CARRIED OUT MULTILATERALLY. IN
COUSE OF DISCUSSION, MINISTER SPECIFICALLY ASKED ABOUT
US-SOVIET EXCHANGE ON GEOTHERMAL ENERGY.

AT CONCLUSION, MINISTER STATED HIS MINISTRY SHOULD BE CONTACT
POINT ON PROJECT, AND WOULD PASS ON INFORMATION TO OTHER
CONCERNED AGENCIES. VOLPE

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